U. S. Geological Survey.

REPORTS-OPEN FILE SERIES, no. 1637: 1971.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Saudi Arabia Investigation Report
(IR) SA-131

GEOCHEMICAL MAPS OF SAMRAH AND VICINITY
KINGDOM OF SAUDI ARABIA

by

Paul K. Theobald and Charles E. Thompson
U. S. Geological Survey

1971

U.S GEOLOGICAL SURVEY
WASHINGTON, D. C
20242

For release DECEMBER 17, 1971

The U.S. Geological Survey is releasing in open file the following reports. Copies are available for inspection in the Geological Survey Libraries, 1033 GSA Bldg., Washington, D.C. 20242; Bldg. 25, Federal Center, Denver, Colo. 80225; and 345 Middlefield Rd., Menlo Park, Calif. 94025. Copies are also available for inspection at other offices as listed:

1. Geochemical maps of Samrah and vicinity, Kingdom of Saudi Arabia, by Paul K. Theobald and Charles E. Thompson. 9 p., 8 figs.

2. A meteorite fall near Sakakah, Kingdom of Saudi Arabia, by William R. Greenwood, Donald H. Johnson, and Mohammed Sultan Bahabri. 15 p., 1 fig.

3. Analyses of samples and preliminary geologic summary of barite-silver-base metal deposits near Glacier Creek, Skagway B-4 quadrangle, southeastern Alaska, by E. M. MacKevett, Jr. 8 p., 2 figs., 1 table. Brooks Bldg., College, Alaska 99701; 441 Federal Bldg., Juneau, Alaska 99801; 108 Skyline Bldg., 508 2nd Ave., Anchorage, Alaska 99501; 678 U.S. Court House Bldg., Spokane, Wash. 99201; 504 Custom House, San Francisco, Calif. 94111; 7638 Federal Bldg., Los Angeles, Calif. 90012; 1012 Federal Bldg., Denver, Colo. 80202; and in offices of the Alaska Div. of Geological Survey, 509 Goldstein Bldg., Juneau, Alaska 99801; 323 E. 4th Ave., Anchorage, Alaska 99504; and University Ave., College, Alaska 99701. [Material from which copy can be made at private expense is available in the Alaskan Mineral Resources Branch, USGS, 345 Middlefield Rd., Menlo Park, Calif. 94025.]

* * *

The following report is also placed in open file and is available for inspection at the Geological Survey Library, 1033 GSA Bldg., Washington, D.C. 20242; USGS, Room LL-3, 301 W. Cumberland Ave., Knoxville, Tenn. 37902; Virginia Div. Mineral Resources, P.O. Box 3667, Charlottesville, Va. 22903; North Carolina Div. Mineral Resources, P.O. Box 2719, Raleigh, N.C. 27602; Georgia Dept. of Mines, Mining, and Geology, 19 Hunter St., S.W., Atlanta, Georgia 30334:

4. Selected fluvial monazite deposits in the southeastern United States, by William C. Overstreet, Amos M. White, Paul K. Theobald, Jr., and Dabney W. Caldwell. 108 p., 4 pl., 1 fig., 17 tables.

* * *

GEOCHEMICAL MAPS OF SAMRAH AND VICINITY
KINGDOM OF SAUDI ARABIA

by

Paul K. Theobald and Charles E. Thompson

CONTENTS

ILLUSTRATIONS

CONTENTS (Cont'd.)

PREFACE

In 1963, in response to a request from the Ministry of Petroleum and Mineral Resources, the Saudi Arabian Government and the U. S. Geological Survey, U. S. Department of the Interior, with the approval of the U. S. Department of State, undertook a joint and cooperative effort to map and evaluate the mineral potential of central and western Saudi Arabia. The results of this program are being released in USGS open files in the United States and are also available in the Library of the Ministry of Petroleum and Mineral Resources. Also on open file in that office is a large amount of material, in the form of unpublished manuscripts, maps, field notes, drill logs, annotated aerial photographs, etc., that has resulted from other previous geologic work by Saudi Arabian government agencies. The Government of Saudi Arabia makes this information available to interested persons, and has set up a liberal mining code which is included in "Mineral Resources of Saudi Arabia, a Guide for Investment and Development," published in 1965 as Bulletin 1 of the Ministry of Petroleum and Mineral Resources, Directorate General of Mineral Resources, Jiddah, Saudi Arabia.

GEOCHEMICAL MAPS OF SAMRAH AND VICINITY
KINGDOM OF SAUDI ARABIA

by

Paul K. Theobald and Charles E. Thompson

ABSTRACT

Geochemical maps of Samrah and vicinity, near Ad Dawadimi, display anomalies for the ore metals over each of the major ancient mining sites, a large contamination anomaly over the ancient ore-processing waste, and less-well defined anomalies parallel to mineralized structures. Zirconium and lanthanum display negative anomalies over altered rocks, do not display the contamination anomaly, and, for zirconium, identify the west workings at Samrah as the site of most intense alteration.

INTRODUCTION

The Samrah ancient silver mine is about 15 kilometers south of Ad Dawadimi at lat 24°22'N; long 44°22'E. Thor H. Kiilsgaard (1970) summarizes previous work in the area: "Karl S. Twitchell examined the mine in 1931 and samples some of the ancient dumps. The deposit was studied in more detail by Richard G. Bogue (unpub. data, 1954), who recommended that ancient tailing dumps be sampled and that diamond drilling be done to determine the persistence and grade of the veins at depth. Harold A. Quinn (1964) studied the mine and nearby deposits and laid out a proposed drilling diamond project. The geology of the Samrah mine and vicinity was mapped by Paul K. Theobald, Jr. (1970).

Theobald also laid out Drill Hole No. 1 and prepared a detailed description of the findings in that hole (Theobald and others, 1970)." A total of 3,624 meters were drilled in 18 holes; the last was completed during the spring of 1967. Kiilsgaard visited the area in May 1968 and studied drill logs, sample data, published and unpublished reports; he prepared (1970) an evaluation of the diamond drilling program and also summarized the geology and calculated the reserves.

The results of geochemical surveys of Samrah and vicinity made in connection with geologic mapping the author did there earlier have been studied and geochemical maps have been prepared. The Directorate General of Mineral Resources has asked that these maps be released in report form so as to be useful to the Directorate in its work now under way at Samrah.

The attached suite of eight geochemical maps (figs 1-8) display variations in three groups of elements in the 30- to 80-mesh fraction of wadi sediment from Samrah and its vicinity. The maps show drainage, major mines, and slag piles for the same area as the geologic map of Samrah and vicinity that accompanies the earlier report by Theobald (1970). They are intended for use with that map and, like it, are compiled on an uncontrolled mosaic from aerial photographs. All of the analytical data was determined by optical emission spectrography in the laboratory in Jiddah. The analytical and sampling precision have been discussed by Theobald and Thompson (1968). The data presented here in the maps for lead, zinc, silver, and, particularly, zirconium were used with the geologic map to locate the first drill hole at Samrah (Theobald, Thompson, and Horn, 1970).

The maps are divided into three groups for convenience in the brief discussion that follows. These groups are (1) the ore metals, lead, zinc, silver, copper, and molybdenum (figs. 1-5), (2) zirconium and lanthanum (figs. 7 and 8), elements depleted in the alteration zone at Samrah, and (3) the other elements (fig. 6).

THE ORE METALS

The distribution patterns for all five of the elements enriched in the ore zone are remarkably similar. With the exception of the weak anomalies for copper, and molybdenum metals sparsely represented in the ore, all of the patterns display anomalies over each of the major ancient mining areas except Samrah East. The major anomaly for each element is centered over the valley southeast of Samrah and results from the accumulation of mill tailings piled in this valley by the ancient miners. A weaker south lobe of this anomaly is evidently related to the arcuate area of slag piles. When these two sources of contamination are identified and mentally removed from the major anomaly, a pair of "residual" anomalies at a considerably lower level than the contamination anomaly can be recognized. These are parallel to and along the principal northeast trending vein system at Samrah - and indicate extension of this system well to the southwest of its outcrop - and along the dike swarm extending east across the Samrah vein system from Ahfore to the Dyke mine. The intersection of these two mineralized structural elements was chosen as the most likely site for ore.

ELEMENTS DEPLETED IN THE ALTERATION ZONE

The distribution pattern for zirconium is striking. From a regional background of 50 to 100 ppm, the values drop to 10 ppm in a low centered over the western mine workings at Samrah. The major low is interrupted over the contaminated valley where values of 50 ppm predominate. We interpret this negative anomaly to reflect removal of zirconium from the altered country rock surrounding the vein system. Evidently the material introduced in the veins themselves is little different from the unaltered country rock in terms of zirconium content, hence the interruption of the negative anomaly in the area of maximum contamination. Thus the zirconium distribution offers a means of bypassing the major problem of contamination and led to choice of the western workings at Samrah as the ultimate goal of the first drill hole.

Lanthanum distribution provides some confirmation of the negative zirconium anomaly. Unfortunately, the lanthanum background is near the analytical sensitivity, and no good definition of a negative anomaly is possible. However, the frequency of detectable lanthanum in the area remote from Samrah is sufficient to allow confidence that the absence of any detectable lanthanum near Samrah reflects removal attending alteration.

OTHER ELEMENTS

Maps of the distribution of titanium, cobalt, chromium and nickel have been compiled, but only that for cobalt is included (fig. 6). We see nothing in any of these patterns that can be related with confidence to the ore potential of the base metal mines in the vicinity. An increase in all of these metals at the northwest corner of the map, north of Ar Rudahat, results from proximity to the edge of a mafic ring complex in this area.

REFERENCES CITED

Kiilsgaard, Thor H., 1970, Evaluation of a diamond drilling program at the Samrah mine, near Ad Dawadimi, Kingdom of Saudi Arabia: U. S. Geol. Survey open file rept. (IR) SA-106, 76 p., 13 figs.

Quinn, Harold A., 1964, Geology, silver mines, and lithium minerals of Ad Dawadimi area: Saudi Arabia Ministry of Petroleum and Mineral Resources, Progress rept. no. 2.

Theobald, Paul K., Jr., 1970, Geology of Samrah and vicinity, Kingdom of Saudi Arabia: U. S. Geol. Survey open file rept. (IR) SA-42, 24 p.

Theobald, Paul K., Jr., and Thompson, Charles E., 1968, Experimental error in sample preparation and spectrographic analysis in the Jiddah laboratory, Saudi Arabia: U. S. Geol. Survey open file rept. (IR) SA-26, 5 p.

Theobald, Paul K., Jr., Thompson, Charles E., and Horn, H. D., 1970, Geologic log and chemical data, diamond drill hole 1, Samrah, Kingdom of Saudi Arabia: U. S. Geol. Survey open file rept. (IR) SA-86, 61 p.

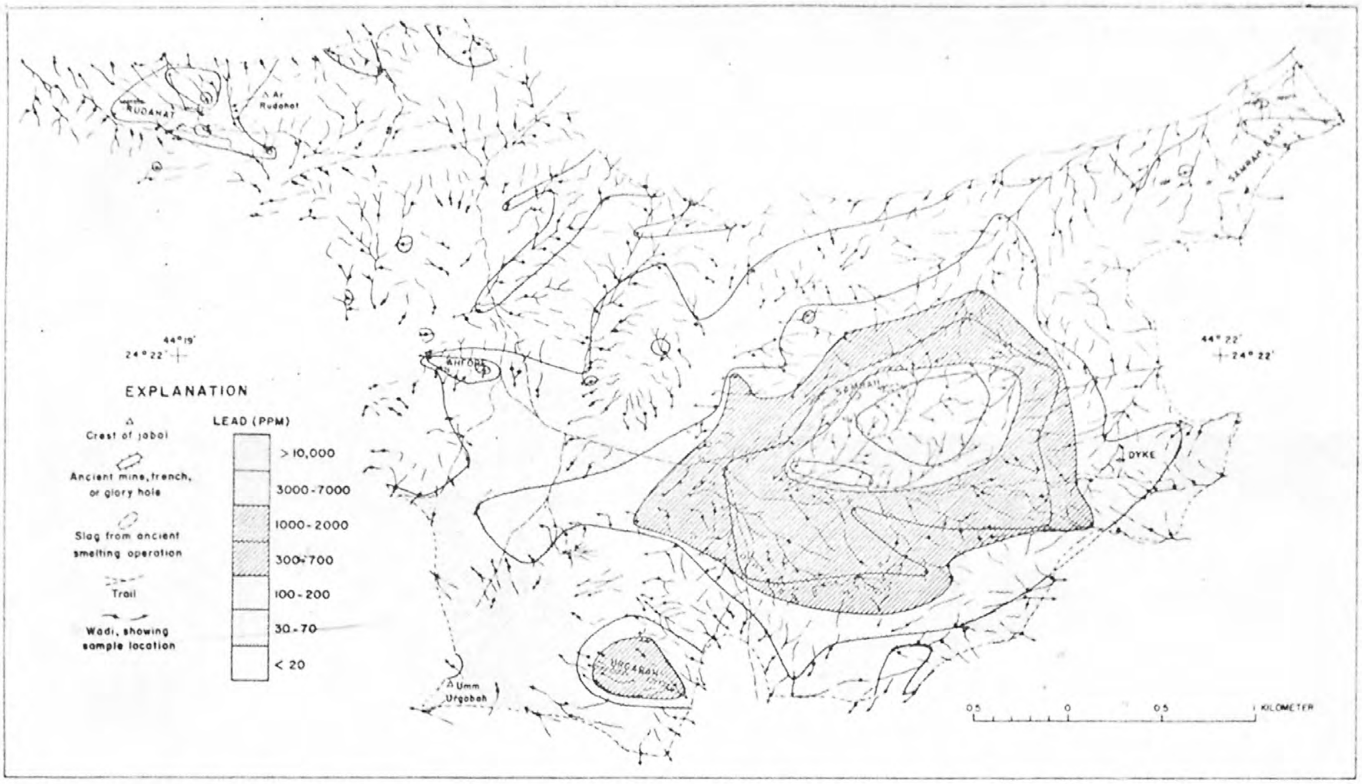

Figure 1.- Geochemical map of Samrah and vicinity showing the distribution of lead in wadi sediment (30 to 80 mesh).

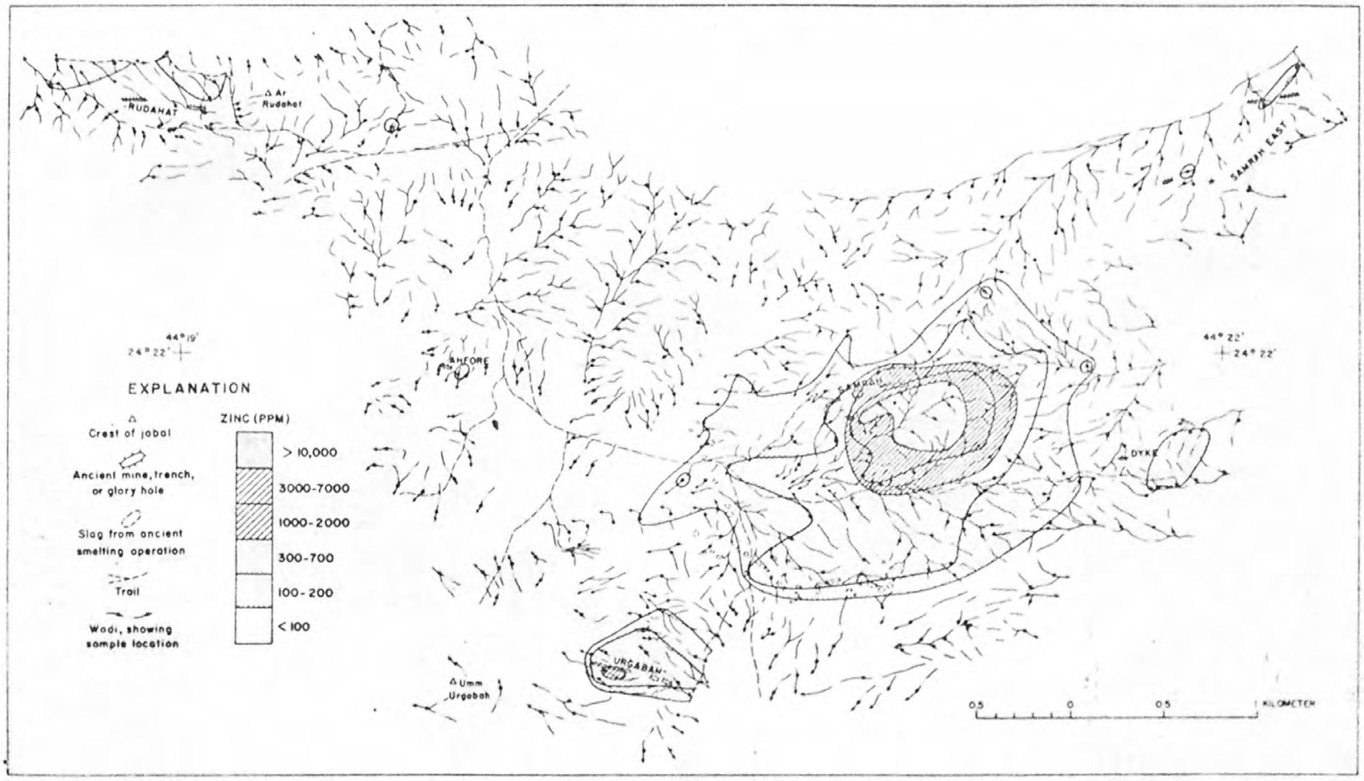

Figure 2.- Geochemical map of Samrah and vicinity showing the distribution of zinc in wadi sediment (30 to 80 mesh).

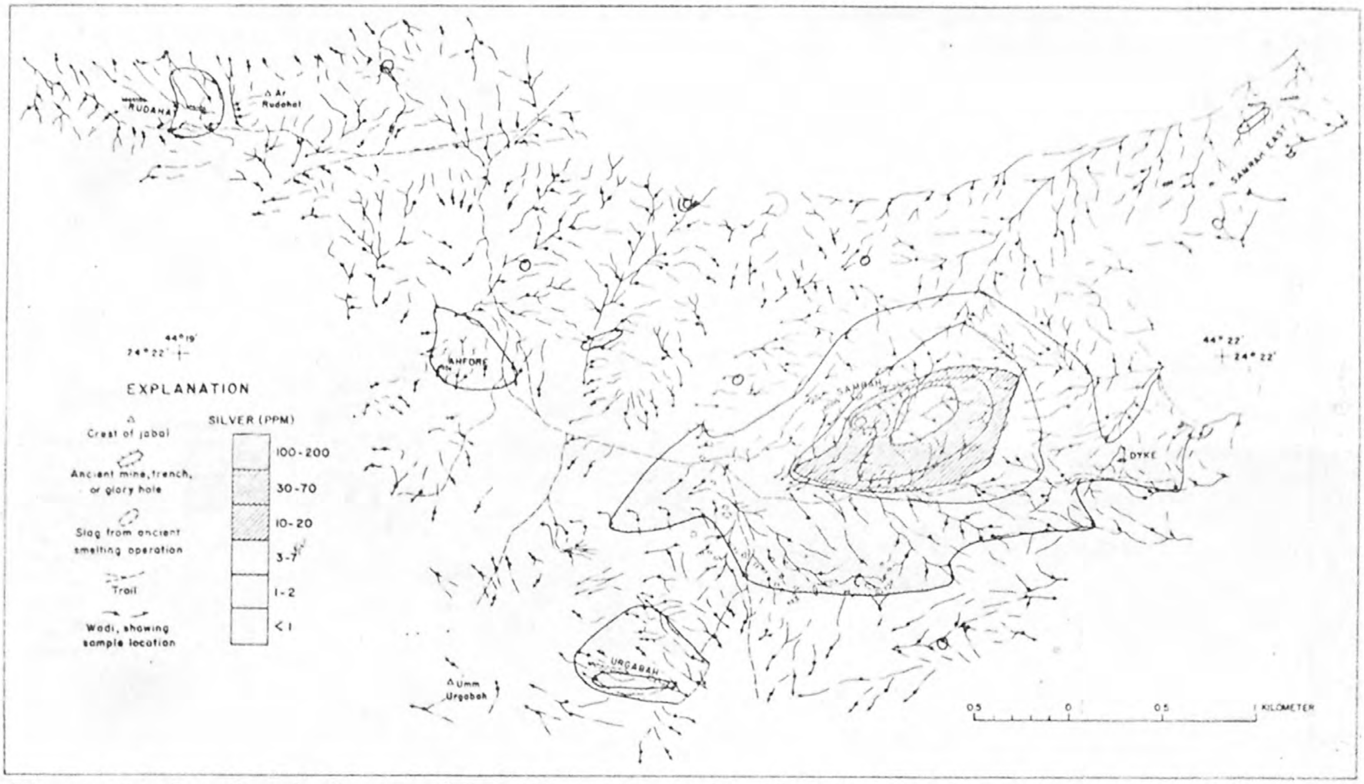

Figure 3.- Geochemical map of Samrah and vicinity showing the distribution of silver in wadi sediment (30 to 80 mesh).

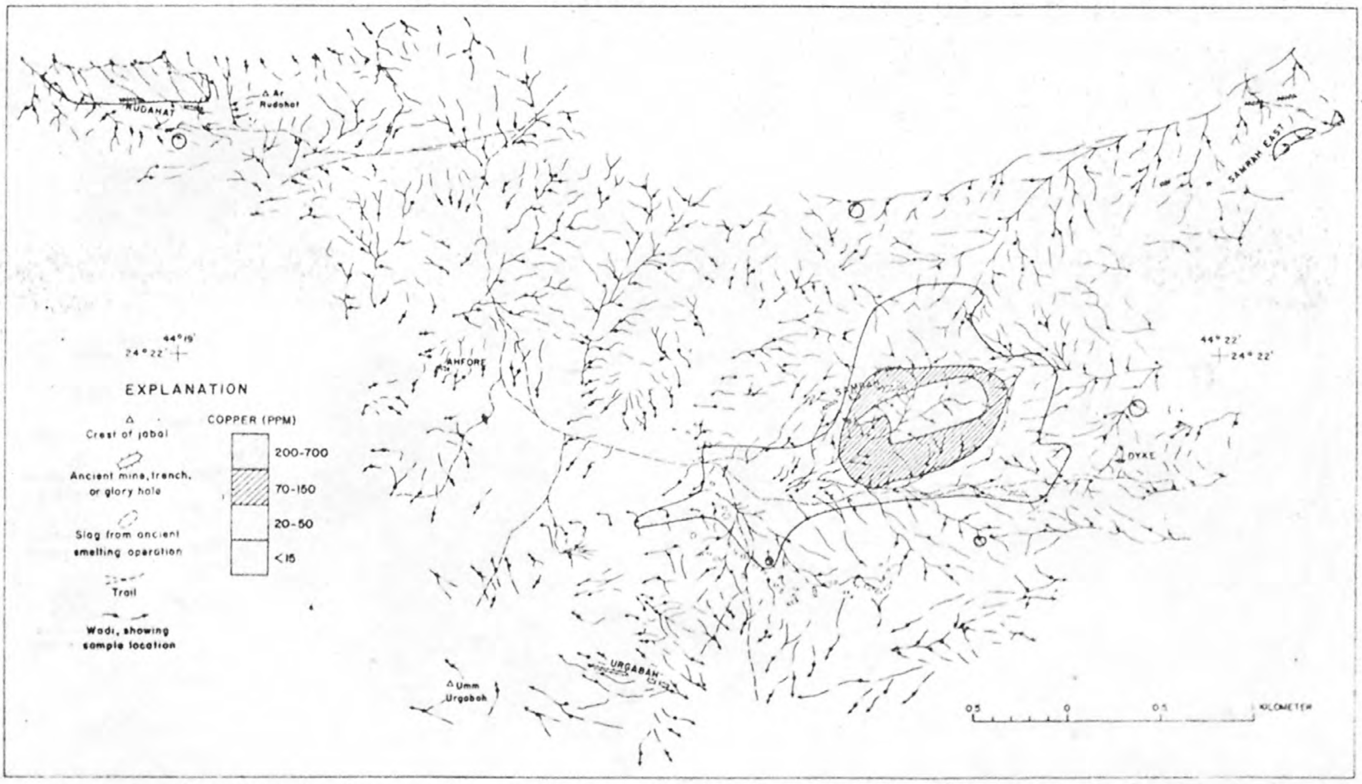

Figure 4.- Geochemical map of Samrah and vicinity showing the distribution of copper in wadi sediment (30 to 80 mesh).

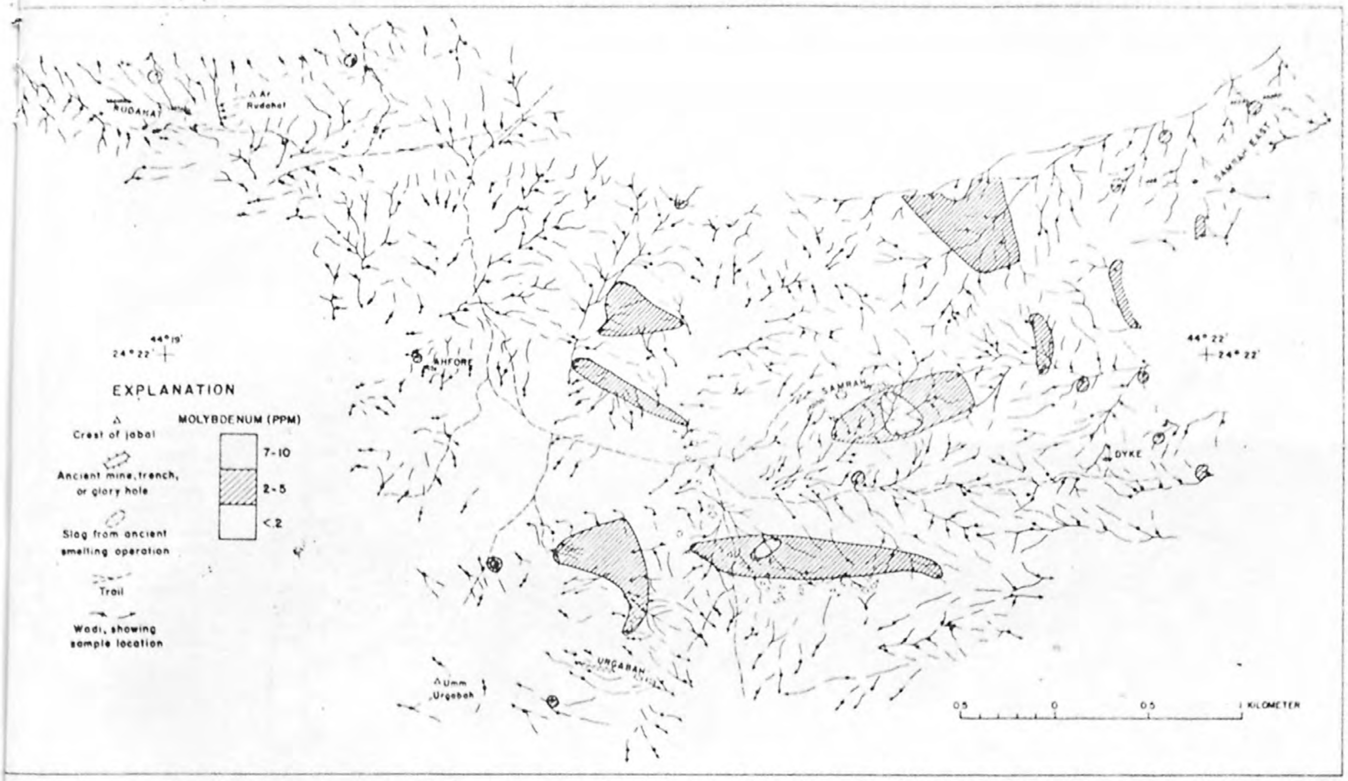

Figure 5.- Geochemical map of Samrah and vicinity showing the distribution of molybdenum in wadi sediment (30 to 80 mesh).

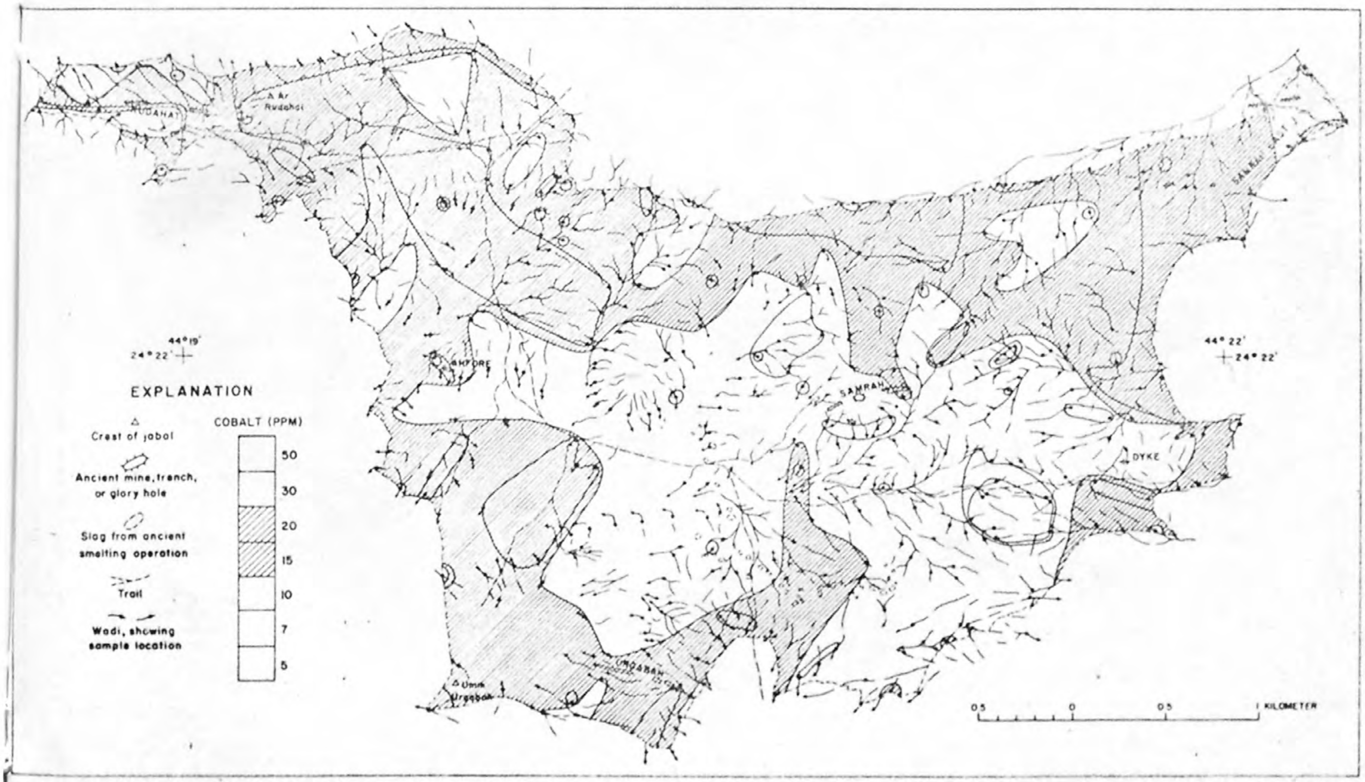

Figure 6.- Geochemical map of Samrah and vicinity showing the distribution of cobalt in wadi sediment (30 to 80 mesh).

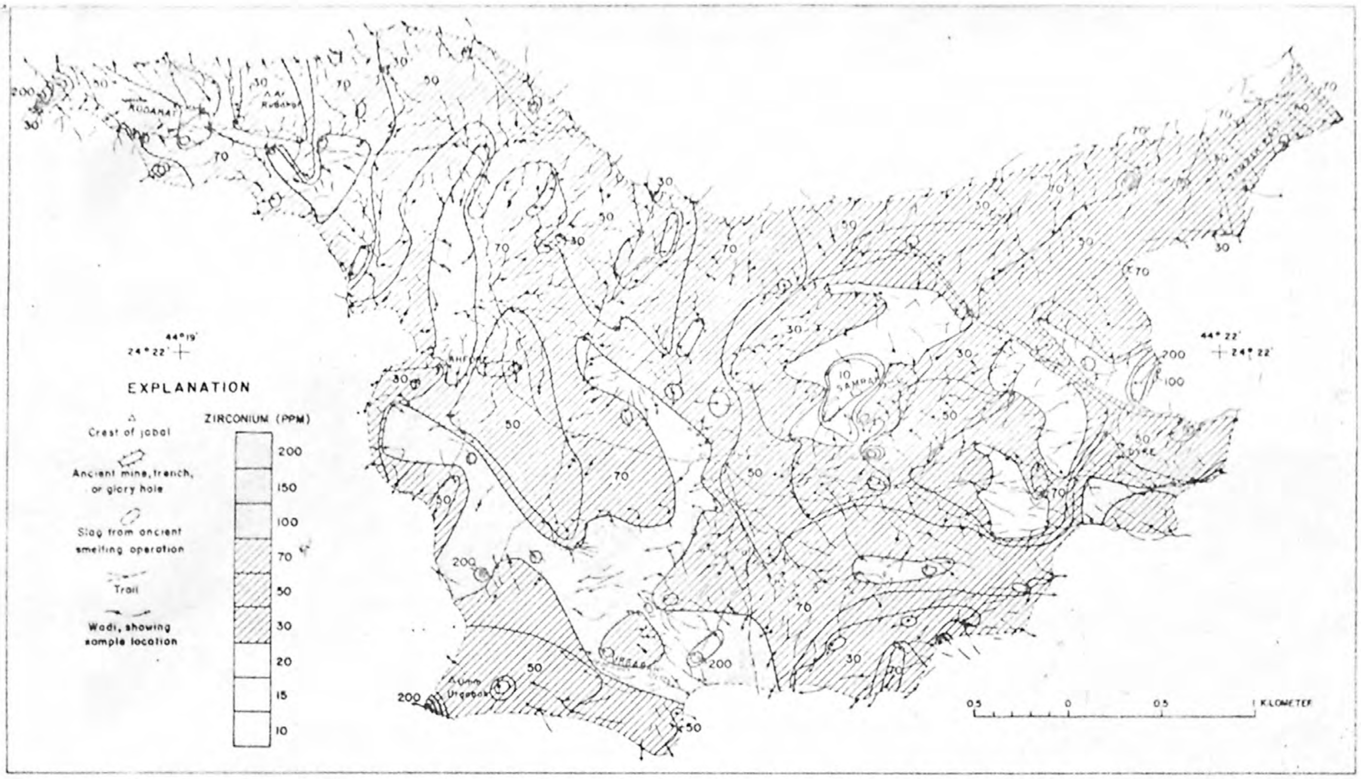

Figure 7.- Geochemical map of Samrah and vicinity showing the distribution of zirconium in wadi sediment (30 to 80 mesh).

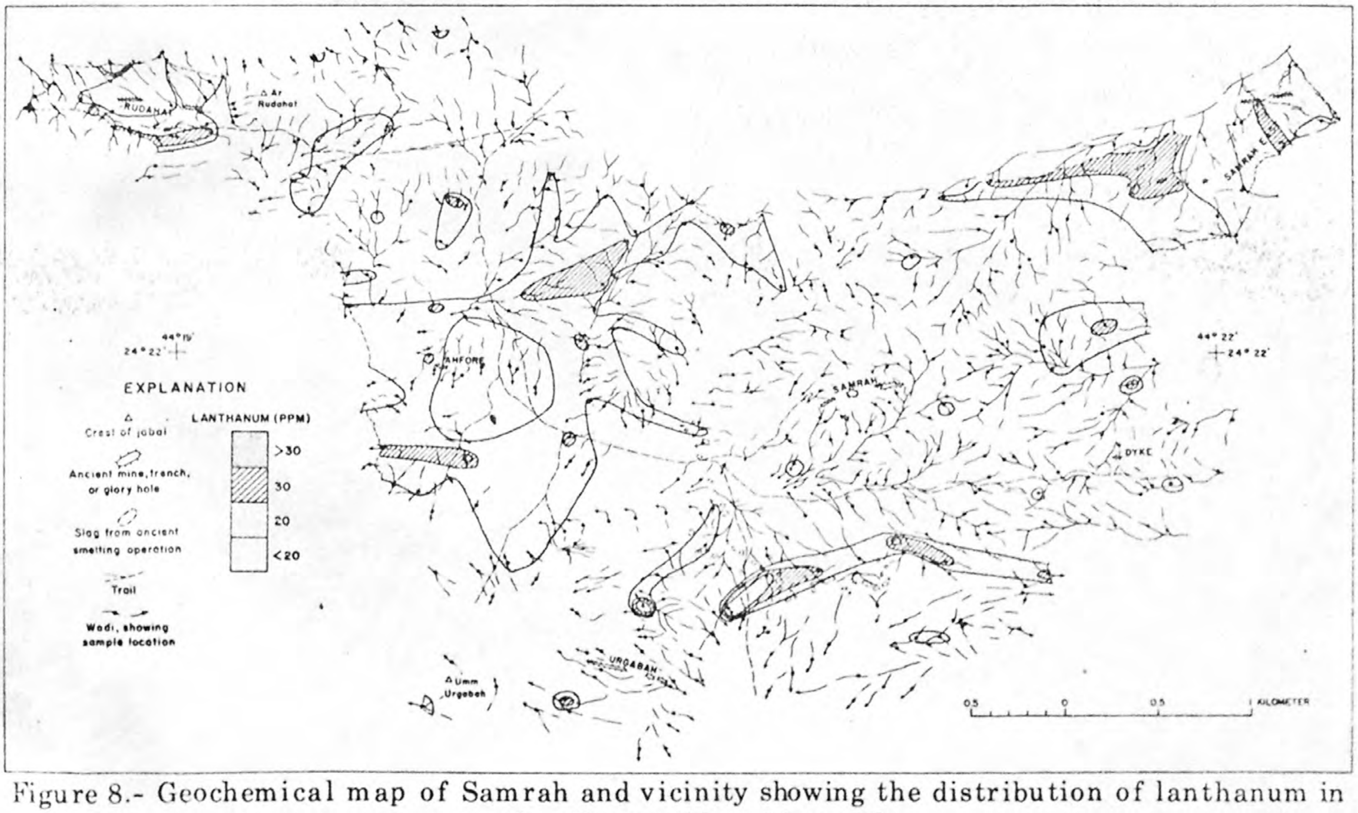

Figure 8.- Geochemical map of Samrah and vicinity showing the distribution of lanthanum in wadi sediment (30 to 80 mesh).